FINAL

PARAGRAPH 10
APRIL 24, 1998 CONSENT DECREE
THE BARRY FARM RESIDENT COUNCIL, INC., ET. AL. (PLAINTIFFS) AND THE DEPARTMENT OF THE NAVY AND THE GSA (DEFENDANTS)

CORRECTIVE MEASURES STUDY REPORT:

EVALUATION OF ALTERNATIVES FOR CLEAN-UP OF CONTAMINATED ANACOSTIA RIVER NEAR SHORE SEDIMENTS ADJACENT TO THE SOUTHEAST FEDERAL CENTER, WASHINGTON, D.C.

Prepared for

U.S. General Services Administration
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1.0 INTRODUCTION

U.S. General Services Administration National Capital Region (GSA) submits this Near Shore River Sediment Corrective Measures Study Report to address Anacostia River sediments located offshore of the Southeast Federal Center (SEFC). GSA is the current custodian of the SEFC, which is owned by the Federal Government. This report reviews what is known regarding concentrations of contaminants in sediment within the portion of the Anacostia River just offshore of the SEFC's southern seawall, compares those concentrations to those found in nearby Anacostia River sediment, summarizes results of a comprehensive environmental contaminant study of the Anacostia River, and evaluates the feasibility of cleanup of contaminated sediments just offshore from the SEFC seawall.

This report has been prepared in response to requirements contained in paragraphs 10, 11, and 12 of the *April 24, 1998 Consent Decree (CD) between The Barry Farm Resident Council, Inc., Kingman Park Civic Association, Anacostia Watershed Society; and the Friends of the Earth (Plaintiffs) and the Department of the Navy and the GSA (Defendants)* (CD, 1998). CD requirements, other than those in paragraphs 10, 11, and 12, pertain to either the land portion of the SEFC or the Washington Navy Yard (WNY) and are not addressed in this report.

Paragraph 10 of the CD requires that GSA conduct a near shore river sediment investigation to identify the nature and extent of contamination, and prepare a Corrective Measures Study (CMS). Specifically, this report has been prepared to respond to the requirement in paragraph 10 of the CD for GSA to prepare and submit a CMS report that identifies, screens, and develops alternatives for responding to near shore river sediment contamination.

2.0 BACKGROUND

The SEFC is a 55-acre property located in the Southeast (S.E.) quadrant of Washington, District of Columbia (D.C.). It is bounded by M Street, S.E. to the north, WNY to the east, Anacostia River to the south, and 2nd Street, S.E. to the west (Figure 1). The southern property line of the SEFC extends into the Anacostia River from between approximately 100-feet at the western site boundary to 200-feet at the eastern site boundary.

The GSA received custodianship of the SEFC from the U.S. Department of Navy in 1963. The entire SEFC was the site of industrial manufacturing activities for the first 50-years of the 20th century. These industrial activities were conducted by the U.S. Navy in support of United States defense operations. Strict environmental regulations regarding the storage and management of wastes that were by-products of these industrial activities were not promulgated at the time. Waste management activities related to these industrial activities resulted in negative environmental impacts to soil and groundwater beneath the land portion of the SEFC.

GSA has been performing environmental investigations through consulting services related to the SEFC since 1990.

2.1 Consent Decree Near Shore River Sediment Requirements

Paragraph 10 and Attachment E to the CD require GSA to conduct a near shore river sediment investigation and submit a report documenting the nature and extent of contamination found in the investigation to Region 3 of the U.S. Environmental Protection Agency (USEPA) . This report, *December 2000 Final Data Report, Near Shore River Sediment Sampling, Southeast Federal Center, Washington, D.C.* (URS, 2000), was submitted to the USEPA for review and comment. USEPA accepted the report in 2002 after submission of final responses to review comments (URS, 2002). As a condition of USEPA's acceptance, all data and interpretations in the report had to be incorporated into the overall Resource Conservation and Recovery Act Facility Investigation (RFI) Report prepared for the SEFC.

Paragraph 10 of the CD also requires GSA to prepare and submit a CMS report that identifies, screens, and develops alternatives for responding to contamination revealed by the near shore river sediment investigation for USEPA concurrence. Paragraph 11 of the CD requires GSA to provide CD Plaintiffs with copies of the reports. Paragraph 12 of the CD requires GSA to meet with the Plaintiffs after receipt of USEPA's comments on or concurrence with the CMS report to discuss whether any corrective measures are appropriate with respect to the near shore sediments.

2.2 USEPA Consent Order Overview and Relation to CD Near Shore Sediment Requirements

In order to properly investigate and address potential risks to human health and the environment posed by the impacts to SEFC, the GSA entered into a Final Administrative Order on Consent (CO) under the Resource Conservation and Recovery Act (RCRA) with the USEPA. The CO terms are described in *Docket Number RCRA-III-019AM, August 2, 1999* (USEPA, 1999). The CO, in general, specifies that the SEFC be investigated in accordance with Section 3013 of RCRA. The type of investigation to be conducted for the SEFC, including any sub-divided portion of the SEFC, is referred to as a RCRA Facility Investigation (RFI).

The RCRA Facility Investigation of the SEFC is summarized in two documents as follows: *RCRA Facility Investigation, U.S. Department of Transportation (DOT) Headquarters Site, Southeast Federal Center, Washington, D.C., Final Rev 1, March 19, 2004* (RFI/DOT 2004a) and *RCRA Facility Investigation, 44-Acre Parcel, Southeast Federal Center, Washington, D.C., Rev 0, June 16, 2004* (RFI 2004b). The investigation of the DOT site was conducted separately to facilitate development of that 11-acre land-locked parcel into the current U.S. DOT Headquarters building. River sediment investigation summaries, data summaries and comparisons to risk-based screening levels (RBSL), and evaluations of risks to human health and the environment are included in *RCRA Facility Investigation, 44-Acre Parcel, Southeast Federal Center, Washington, D.C., Rev 0, June 16, 2004,* (RFI 2004b).

The RFI Report (RFI 2004b), including the near shore river sediment data and interpretations, was issued to the USEPA for review and comment on June 16, 2004. Since issuance of the RFI Report, USEPA responded with several rounds of review comments to which GSA has answered. In USEPA comments dated December 9, 2005, GSA was instructed to evaluate the risks to human health and the environment posed by the contaminants detected in near shore river sediments. In response to the USEPA comments, there is an ecological risk evaluation of the near shore sediments sampled and analyzed in the 2000 investigation (URS, 2000). GSA received written clarifications and an agreed upon direction from USEPA as to how to conduct the evaluation in correspondence dated September 20, 2006.

The initial near shore river sediment ecological risk evaluation report was prepared and issued to the USEPA for review and comment on July 5, 2007. USEPA reviewed the initial report and submitted review comments on September 25, 2007. Based on those comments the final risk evaluation report, *Appendix T* (to 44-Acre Parcel RFI Report – RFI 2004b)*: Ecological and Human Health Risk Analysis of River Sediment Data, Southeast Federal Center, Washington, D.C., February 12, 2008* (EHHR, 2008), was issued. The EHHR 2008 report was forwarded to the USEPA by the GSA for review and comment on February 14, 2008. After one further round of review and comment, the USEPA approved the Appendix T near shore river sediment ecological risk evaluation report and the RFI 2004b Report on July 17, 2008.

GSA believes this is the USEPA approval of the investigation report described in Paragraph 10 of the CD. The USEPA CO requires that GSA investigate the entire SEFC, including that portion of the property in the Anacostia River, and assess all risks to human health and the environment posed by contaminants, including river sediment. It also requires that the GSA conduct interim measures (removals of contaminants deemed an unacceptable near-term risk) as directed by the USEPA and determine appropriate corrective measures to mitigate unacceptable risks posed by the contaminated media, including near shore river sediment. In USEPA's approval of Appendix T to the 44-Acre RFI Report, GSA was not directed to recommend or develop any corrective measures.

3.0 SUMMARY OF ANACOSTIA RIVER CONTAMINATED SEDIMENT STUDIES

Four separate investigations conducted on the SEFC have included the collection of near shore river sediment samples from the portion of the Anacostia River within SEFC property boundaries. These included investigations were conducted by Apex Environmental, Inc. (Apex) and Kaselaan & D'Angelo Associates, Inc. (K&D) in 1990 and 1991, respectively, and two investigations conducted by URS in 1995 and 1999. Data from the Apex, K&D, and 1995 investigations were not considered for use in the RFI near shore river sediment ecological risk evaluation (URS, 2008) because they were judged either to be no longer representative or because of concerns about the data validity. A summary of these investigations and reasons for data exclusion are provided below. The 1999 investigation was conducted in accordance with a USEPA reviewed and approved work plan (GWC, 1999) which included detailed sampling, equipment decontamination, sample and analysis quality assurance, and data validation (results verification and confidence evaluation) procedures.

The Anacostia River watershed spans three main jurisdictions: Prince George's and Montgomery Counties in Maryland and the District of Columbia. In order to effectively address the complex environmental issues in the watershed, a phased holistic approach was adopted by Federal, State, and local municipal governments, citizenry action organizations, and commercial firms with property along the Anacostia River. To facilitate this innovative approach and assure successful management of this natural resource, concerned stakeholders have joined together to pool knowledge, expertise, and resources, and to work together to address the many environmental problems. These groups include the Anacostia Watershed Toxics Alliance (AWTA), Anacostia Watershed Restoration Committee (AWRC), and the Anacostia Watershed Society (AWS). AWTA and AWRC have been the primary repositories of data from a myriad of studies conducted to assess contamination of the Anacostia River, including those conducted by the GSA for the SEFC. Results of the studies were compiled and in 2002 AWTA and AWRD jointly issued a management strategy for restoration of the Anacostia River: *Charting a Course Toward Restoration: A Toxic Chemical Strategy for the Anacostia River* (AWTA and AWRC, 2002). In regard to river sediment contaminants in the Anacostia River, the AWTA and AWRC, 2002 report summarizes the results of over 600 samples collected throughout the river. The report also compiles the results of numerous and related ecological risk assessments and presents numeric criteria, Threshold Effects Limit (TEL) and Probable Effects Limit (PEL), specific to the Anacostia River that predict whether a given sediment contaminant concentration is likely to present a threat to the river ecosystem.

3.1 1990 SEFC Investigation

In 1990, Apex conducted a Phase I Environmental Site Assessment (ESA) of the SEFC for the GSA (Apex, 1990). As part of their ESA, four samples of near shore river sediment were collected from the Anacostia River to assess the quality of the river-bottom material along the SEFC waterfront. The samples were analyzed for priority pollutant metals, pesticides, and polychlorinated biphenyls (PCB). These sediment samples locations no longer represent near shore conditions, as the sediments were excavated to construct a replacement seawall along the SEFC waterfront that was completed in January 2001 (RFI 2004b).

3.2 1991 SEFC Investigation

In 1991, K&D conducted a Phase II ESA of the SEFC for the GSA (K&D, 1991). As part of their ESA, samples of near shore river sediment from the Anacostia River were collected to assess the quality of the river-bottom material along and beneath the previously existing seawall (part of the seawall was built over open water – known as a relieving platform) that forms the southern boundary of the site. Nine of these former near shore sediments samples were collected in areas that were not disturbed by the seawall replacement project. These samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOC), semivolatile organic compounds (SVOC), and pesticides/polychlorinated biphenyls (PCBs), Target Analyte List (TAL) metals, and cyanide. Target base/neutral organic compounds, consisting primarily of polycyclic aromatic hydrocarbons (PAH), were detected in excess of K&D's derived background levels in five of the nine samples. Arsenic, copper, lead, mercury, and zinc were detected at concentrations in excess of background levels. PCBs were also detected in one sample (K&D, 1991). There are concerns about the validity of the data since quality control data were not available for the analyses; therefore, these data were excluded from the near shore river sediment ecological risk evaluation (RFI 2004b).

3.3 1995 SEFC Investigation

In 1995, GSA submitted an application to the United States Army Corps of Engineers (USACE) for a permit under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act for the replacement of the existing seawall at the SEFC. In support of this application, three near shore river sediment samples were collected along the existing seawall to investigate if the sediment constituent concentrations had changed since the K&D study. The sample analysis results were similar to those reported by K&D in 1991. These three sediment samples locations were judged to no longer be representative of river bottom conditions and thus their data excluded from the near shore river sediment ecological risk evaluation (RFI 2004b).

3.4 1999 SEFC Investigation

3.4.1 Investigation Background

In 1995, The Barry Farm Resident Council, Inc., Kingman Park Civic Association, AWTA, and the Friends of the Earth commenced actions against the Department of the Navy and the GSA in the United States District Court for the District of Columbia. In 1998 the Department of the Navy and the GSA entered the CD described in Section 2.0. Under the terms of the CD, the GSA agreed to sample and analyze near shore river sediment along the SEFC waterfront. Sediment sampling locations are shown in Figure 1.

In 1999, GSA conducted field activities consisting of collection of the sediment samples at 11 locations (designated NS-1 through NS-11 on Figure 1). For further details regarding sampling, laboratory analysis of samples, and data evaluations the reader is referred to the URS 2000 and RFI 2004b reports. Locations NS-1, NS-2, NS-3, and NS-4 were originally intended to be within 50- to 100-feet of the outfalls for the two combined sewers adjacent to and downstream of the SEFC. Effluent from the outfalls, with sources from much of Southeast DC, was believed to be a contributor to contaminants detected in near shore river sediments. After numerous unsuccessful attempts to obtain sediment samples at these four locations and at locations up to 400-feet further away from the shoreline, a decision was made to relocate the sampling locations. NS-4 was moved to the location shown on Figures 1, 2, and 3 to provide some data on the effect effluent from one of the combined sewer outfalls may have on contamination of near shore river sediments. This was the location nearest the outfalls where an adequate amount of sediment could be retrieved for sampling. Locations NS-1, NS-2, and NS-3 were relocated upstream of the nearest work plan proposed upstream sampling location, NS-11. They were relocated to provide information on near shore river sediment contaminant concentrations near the stormwater outfalls that discharge at the end of Pendleton Street and Bowyer Street from the WNY (Figure 1).

3.4.2 Investigation Results

In August 1999, a total of 13 near shore sediment samples (11 samples and two quality control duplicate samples) were collected at 11 locations, designated as NS-1 through NS-11 on Figures 1, 2, and 3. Each near shore river sediment sample was analyzed for some or all of the following parameters: TAL metals plus tin and cyanide, TCL VOCs, TCL SVOCs, TCL PCBs, PAHs, dioxins and furans, Appendix IX VOCs, Appendix IX

SVOCs, PCB congeners (all 209), sulfide, total organic carbon, grain size, and acid volatile sulfide.

The results of the grain size, cyanide, sulfide, acid volatile sulfide, and total organic carbon are not discussed here as they are not germane to this report. The reader is referred to the URS 2002 and RFI 2004b reports for details regarding these parameters.

In order to initially identify the individual constituent concentrations that were significant in terms of representing a possible threat to the environment, the results were compared to USEPA U.S. EPA Region III Biological Technical Assistance Group (BTAG) screening values for freshwater sediment (August, 2006 values). Evaluation of sediment by comparison to BTAG freshwater sediment criteria is intended to protect the ability of benthic invertebrate communities to maintain nutrient cycling; provide a food source for upper trophic level receptors; and ensure that contaminant levels in invertebrate tissue are low enough to minimize the risk of bioaccumulation and/or other negative effects to higher trophic levels. Table 1 in URS, 2008 presents the analytical data and the BTAG values for the detected constituents from the 1999 near shore river sediment sampling.

<u>VOCs</u>

One or more target VOCs were detected in all samples. Only four of the detected VOCs have BTAG values: carbon disulfide, chlorobenzene, ethylbenzene and xylenes (total). Concentrations exceeded BTAG values for one compound, carbon disulfide, in the samples from locations NS-4 and NS-5 (see Figure 1 for sample locations).

<u>SVOCs and PAHs</u>

Target SVOCs were detected in all samples. SVOCs (consisting primarily of PAHs) exceeded BTAG values at one or more locations. PAHs were detected in all samples (Figure 3). The suite of PAH compounds that exceeded BTAG values at specific sampling locations were very similar to the suite of SVOCs that exceeded BTAG values at the same locations. Results for total PAHs indicated several of the highest concentrations occurred in the most upstream and downstream sample locations: NS3 and NS4 on Figure 3. The highest total PAH concentration was at NS4, the sample location closest to the D.C. Water and Sewer Authority (WASA) O Street combined sewer outfall (Figure 3). No clear pattern or source was evident from the total PAH sediment data other then the possible impact from the outfall (Figure 1).

<u>PCBs</u>

In accordance with the USEPA approved work plan (URSGWC, 1999b), only three samples were analyzed for all 209 PCB congeners (isomers of the chlorinated biphenyl molecule). The remaining 10 samples were analyzed for PCB Aroclors. Twenty of the 209 congeners are used in the U.S. National Oceanic and Atmospheric Administration's (NOAA) National Status and Trends Mussel Watch Program and are considered target PCB compounds in USEPA's Environmental Monitoring and Assessment Program. PCBs were detected 8 of the 11 sample locations (Figure 2). The highest concentrations PCB Aroclors were detected at the two most downstream locations, NS4 and NS5, and at the two most upstream locations, NS3 and NS11 (Figure 2). Sample locations NS4 and NS5 are closest to the WASA O Street combined sewer outfall. PCB Aroclor and congener concentrations to BTAG comparisons were not conducted because BTAG values for these constituents had not been published when the comparisons were made.

Metals

Twenty of 24 TAL metals were detected in all samples. Concentrations of cadmium, copper, lead, nickel, silver, and zinc exceeded BTAG values at all 11 locations. BTAG values were exceeded for chromium at nine locations and for iron and manganese at eight locations. The uniformity of exceedances was believed to indicate either a regional contaminant influence or constituent concentrations inherent to the sediment itself (URS, 2004b).

Dioxin and Furan

All 17 target dioxin/furan compounds were reported as detected in the three samples analyzed for these compounds. Samples from the remaining eight locations were not analyzed for dioxin/furan compounds. Only one dioxin (2,3,7,8-TCDD) has a published BTAG value. The 2.3.7.8-TCDD concentrations in all three samples exceeded the BTAG value.

The investigation concluded that based on the 11 data points, impact to sediments in this reach of the Anacostia River by PCBs and metals was indicated. SVOC and PAH impacts to sediment were indicated at the upstream and downstream sample locations. Dioxin and furan impacts above background levels are indicated, although not at a level of concern if the river sediment were considered to be in a residential land use setting (URS, 2004b).

3.5 AWTA and AWRC Compilation of Anacostia River Sediment Investigation Results

In 2001 NOAA published a comprehensive report that included statistical analysis of all sediment contamination data AWTA and AWRC had received and compiled (Buchman, 2001). As a member of AWTA, NOAA was the lead Federal agency charged with managing and analyzing the large amounts of study data provided by AWTA and AWRC members. AWTA's analysis of data indicated that PCBs and PAHs were the primary contaminants of concern in Anacostia River sediments, with certain metals being of secondary concern.

Through detailed, rigorous, and peer reviewed risk analyses of the effects the contaminated sediments would have on benthic life (that which lives in and on the river sediment) AWTA arrived at a two-tiered RBSL hierarchy. These screening levels are the TEL, which is the concentration of a particular contaminant below which adverse biological effects are expected to rarely occur, and the PEL, which is the concentration above which adverse effects are expected to frequently occur. Sediment TELs and PELs were derived based on the compiled sediment and water quality database, and sediment toxicity studies conducted by AWTA members and partners. The Anacostia River is a freshwater body and freshwater TELs and PELs tend to be more robust because the database is roughly split between toxicity studies and benthic community assessment metrics.

AWTA's published TELs and PELs for PCBs and PAHs are as follows:

- Total PCBs in sediment: TEL = 34.1 parts per billion (ppb), PEL = 227 ppb
- Total Group 1 PAHs (represented by phenanthrene): PEL = 515 ppb
- Total Group 2 PAHs (represented by benzo(a)anthracene): TEL = 31.7 ppb, PEL = 385 ppb
- Total Group 3 PAHs (represented by benzo(a)pyrene): TEL = 31.9 ppb, PEL = 782 ppb

Figures 4, 5, 6, and 7 graphically depict the concentration distributions of total PCBs and total PAH groups 1, 2, and 3, respectively. These figures were obtained from the District Department of the Environment's May 2008 *Anacostia 2032: Plan for a Fishable and Swimmable Anacostia River* report (DDOE, 2008).

Figures 4, 5, 6, and 7 indicate high concentrations of PCBs and PAHs are evident at several points along the river. In relation to the SEFC there appears to be a "hot spot" of sediment PCB and PAH contamination offshore of the SEFC extending east (upstream) to the WNY and west (downstream) to beyond the WASA O Street combined sewer outfall (CSO), and south to the opposite shoreline. In AWTA's 2002 report this "hot spot" area was designated as the O Street Outfall Cluster (Figure 8).

A comparison of the AWTA 2000 PELs to the river sediment contaminant concentrations revealed in the 1999 SEFC Investigation (hereinafter referred to as the 1999 River Sediment Data) reveals the following:

- Total PCB concentrations exceed the PEL at only the two eastern (upstream near WNY)) sampling locations NS2 and NS3 and two western (downstream near the WASA CSO) sampling locations NS4 and NS5 (see Figure 2)
- Total PAH concentrations exceed the aggregate PEL (sum of three PAH Group PELs), which is equivalent to 1,682 ppb, at all but one location NS1 (see Figure 3)

4.0 SUMMARY OF RISKS POSED TO ECOLOGICAL RECEPTORS

In accordance with a directive from USEPA, dated September 20, 2006, the potential for ecological risk associated with chemicals detected in sediments collected near shore at the SEFC is to be assessed. Agreement was reached between USEPA and GSA on November 9, 2006 regarding the methodology, governing assumptions, and risk evaluation models to be used. Final agreement on the data sets to be used was reached on November 14, 2006 (URS 2008). An additional USEPA directive, dated September 25, 2007, requires that GSA conduct a screening level human health risk evaluation for fish consumption using sediment data from the Anacostia River (AWTA/NOAA data set). Agreement was reached by USEPA and GSA on December 14, 2007 governing the methodology, assumptions, risk evaluation models, and river sediment data that were to be used. USEPA and GSA agreed that the AWTA river sediment chemical constituent data available at that time (NOAA, 2001) would be used in the human health risk evaluation for fish consumption because it is more representative of contaminant conditions in the Anacostia River watershed and would better account for the migratory nature of fish and the resulting variations in fish tissue contaminant bioaccumulation. The results of the human health and ecological risk evaluations are documented in the URS, 2008 report and are summarized in Section 4.1.

In 2001 AWTA and AWRC issued a report summarizing the results of their evaluation of all available Anacostia River data, including sediment contaminant data, received by them (AWTA, 2002). The report summarized what was known, identified data gaps, developed RBSLs for contaminated sediments (TELs and PELs), evaluated various management strategies (corrective measures) for controlling further sediment and contaminant input into the river, evaluated corrective measures for contaminated sediment "hot spots" or areas of concern (AOC) they identified, and made recommendations on preferred corrective measures for each AOC. In their report, AWTA (AWTA, 2002) identified six AOCs including three in the vicinity of the SEFC: O Street Outfall Cluster (AOC 1), Stickfoot Sewer (AOC 4), and AOC which they describe as all other sediments not in AOC 1 or AOC 4 that lie between the South Capital Street and 12th Street Bridges (Figure 9). Those same AOCs and their associated comparable recommended corrective measures are confirmed in AWTA's recent (Draft) White Paper on PCB and PAH Contaminated Sediments in the Anacostia River (AWTA, 2008).

4.1 Human Health and Ecological Risk Evaluation of Sediments Along SEFC Waterfront

On behalf of GSA, a quantitative screening-level risk evaluation for four ecological receptors: benthic invertebrates, an herbivorous semi-aquatic animal (muskrat), a bird feeding on aquatic life (great blue heron), and fish feeding on benthic invertebrates (pumpkinseed fish) were performed. The purpose of the evaluation was to predict whether or not contaminant concentrations detected during the 1999 SEFC Investigation posed a recognizable risk to human health and the environment (URS, 2008). To estimate exposures for the screening-level evaluation, complete exposure pathways were identified and the highest measured on-site contaminant for sediment was used. Risk was estimated using exposure estimates and screening eco-toxicity values. For the screening-level risk calculation, the hazard quotient (HQ) approach, which compares estimates of screening eco-toxicity values and exposure values, was used to estimate risk. The HQ is expressed as the ratio of a potential exposure level to the no-observed-adverse-effects-level.

A HQ of less than 1.0 (unity) indicates that the contaminant alone is unlikely to cause adverse ecological effects. A HQ of greater than 1.0 indicates the potential for an adverse effect due to exposure to the contaminant being evaluated. Details on the calculations and results for individual receptors are contained in the URS, 2008 report.

The evaluation concluded the following:

- Concentrations of one dioxin compound, PAHs, 10 metals, and one VOC are above those considered to have an adverse effect on benthic invertebrates
- Concentrations of five metals are above those considered to have an adverse effect on herbivorous semi-aquatic mammals, represented by the muskrat
- Concentrations of PCBs and three metals are above those considered to have an adverse effect on birds which feed on aquatic life, represented by the heron
- Concentrations of two PCBs, PAHs, and nine metals are above those considered to have an adverse effect on fish which feed on benthic organisms, represented by the sunfish

These observations must be considered as possibilities rather than certainties as this is the nature of an ecological screening-level evaluation (URS, 2008).

Results of the human health screening-level evaluation of data from samples collected by others (NOAA, 2001 database) in the reach of the Anacostia River adjacent to the SEFC indicate that concentrations of total PCBs, PAHs, and nine metals are above those considered to have adverse effects on the health of a hypothetical recreational fisherman consuming fish from the river.

The evaluation also included comparing contaminant levels detected in the near shore river sediments along the SEFC waterfront to those detected in other Anacostia River sediments (those in the NOAA, 2001 database). To evaluate if there are unique and significantly different contaminant concentrations and distributions in sediments near the SEFC to those in sediment from other sources (primarily industrial facilities and combined sewer outfalls) in the Anacostia River, comparisons of average concentrations were performed for several groupings of river data. Analytical results from the sediment sampling event conducted for the WNY and sediment sampling events conducted by the National Academy of Sciences (NAS) and the Space and Warfare Command (SWC) were compared to the 1999 River Sediment Data results. Figures 2 and 3 show the locations of these samples and there corresponding total PCB and total PAH concentrations.

Data from these three non-GSA studies were selected because sampling efforts occurred within the last seven years. Additional data in the watershed project database were less current. All samples from these studies that were collected from the reach of the river near the SEFC (from the 11th Street Bridge to the Capital Street Bridge) were included (Figures 2 and 3). Averages were calculated for the following parameters: total PCBs; total PAHs; lead; mercury; silver and copper. Total PCBs and total PAHs were selected because they have been documented as a concern in river-wide sediment (AWTA, 2002; AWTA, 2008; DDOE, 2008). The four metals were selected because they had the highest calculated HQ values resulting from the sediment screening evaluation. This dataset (the combined SPWR and ANS data) was compared to average sediment constituent concentrations detected in the 1999 River Sediment Data. NAS and SWC results were used to create two datasets: average concentrations in the river reach adjacent to SEFC (a.k.a., Recent Watershed Projects Sediment Data) and average background concentrations (a.k.a., Watershed Project Background Sediment Data). A background value for total PAHs was also provided by NOAA staff and was used in the evaluation (URS, 2008).

PCBs

Results of the data comparison for total PCBs indicate that samples from the WNY had the lowest average total PCB concentration (189 ppb). Samples from the 1999 River Sediment Data had the highest average concentration of total PCBs (312 ppb). This average concentration was within the same range as the values calculated for the Recent Watershed Projects Sediment Data (299 ppb) and was reasonably close to the value from the Watershed Project Background Sediment Data (273 ppb).

PAHs

The Recent Watershed Projects Sediment Data had an average total PAH concentration of 18,544 ppb and the Watershed Project Background Sediment Data had an average concentration of 17,075 ppb. These average concentrations are significantly greater than in the 1999 URS samples (8,958 ppb) or the WNY samples (5,835 ppb). A NOAA staff member provided a total PAH background concentration of 21,500 ppb for the reach of the river that was considered in the evaluation (between South Capital Street and 11the Street Bridges).

Metals

Average concentrations of metals are elevated in 1999 River Sediment Data samples compared to those in the other three datasets.

Distribution of PCBs and PAHs in the Study Area

The distributions of total PCBs and total PAHs were evaluated for samples included in the Recent Watershed Projects Sediment Data and those represented by the 1999 River Sediment Data. Elevated concentrations of both parameters are present in the vicinity of the O Street CSO and Stickfoot Sewer, neither of which are part of the SEFC (Figures 2 and 3). This is consistent with the AOCs identified by AWTA – see Figures 8 and 9 (AWTA, 2002 and AWTA, 2008). The O Street CSO is adjacent to the western border of the SEFC and the Stickfoot Sewer is across the river from the SEFC (Figure 8).

4.2 AWTA and AWRC Ecological Risk Evaluation Summary for Anacostia River Sediments

AWTA and AWRC published a management strategy for cleaning up the Anacostia River in 2002. It included the combined results of numerous sediment sampling and analysis studies, benthic organism and fish toxicity studies, ecological risk assessments, and proposed corrective measures strategies to deal with issues ranging from trash entering the river to remedial strategies for contaminated sediments (AWTA, 2002). Much of the contaminated sediment study, risk evaluation, and corrective measures were reiterated in AWTA's 2008 draft White Paper on PCB and PAH Contaminated Sediments in the Anacostia River (AWTA, 2008). As described in Section 4.0 above, AWTA identified six contaminated sediment AOCs in the Anacostia River. The discussion below summarizes the results of AWTA's studies and evaluations that led to the identification of these AOCs, and in particular the ones near the SEFC.

Six AOCs were identified based upon sediment sampling results, a sediment conceptual model, risk based screening, and spatial analysis (Figure 9). The identification of these AOCs was first attempted by comparing sediment contaminant levels in the AWTA database to benchmarks for protection of ecological resources (TELs and PELs). For PCBs, the freshwater TEL of 34 ppb and PEL of 277 ppb were used. The total PCB TEL and PEL are interpreted to be indicative of a low and high probability of adverse risk to benthic ecosystems, respectively. For PAHs, the freshwater TEL of 1,700 ppb and PEL of 2,000 ppb were used. The total PAH TEL is interpreted to be protective of benthic ecosystems and the TEL is a risk threshold for benthic fish (AWTA, 2008).

These initial screenings indicated that total PAH concentrations in sediments exceeded both respective benchmarks throughout the entire river. This suggests all sediments throughout the river have a high degree of confidence of being potentially toxic to benthic organisms and benthic fish. Total PCB concentrations throughout the entire river exceeded the TEL which suggests all sediment throughout the river is potentially toxic to benthic organisms.

Biological observations throughout the river corroborated these results (e.g. tumors on bottom dwelling fish and fish consumption advisories for PCBs). Therefore, AWTA conducted additional evaluations in an attempt to identify discrete AOCs within the polluted river. They conducted a follow-on preliminary spatial evaluation of contaminant data to identify those areas that indicated the greatest degree of contamination. The evaluation resulted in deriving RBSLs for total PCBs and total PAHs as depicted on their Figure 13 in the AWTA, 2002 report and Figure 1 in the AWTA, 2008 report. The RBSLs depicted are 322 ppb for total PCBs and 23,142 for total PAHs.

<u>Comparison of AWTA Derived PCB and PAH RBSLs to 1999 River Sediment Data</u>

Total PCB concentrations in samples from the east and west ends of the 1999 sample collection areas exceeded the AWTA RBSL of 332 ppb as follows: locations NS2 and NS3 at the WNY boundary, and NS4 and NS5 at the boundary with the O Street CSO (Figure 2). Total PAH concentrations exceeded the AWTA RBSL of 21,142 in sediment collected from one location, NS4, which is the location nearest the O Street CSO (Figure 3).

A comparison of the spatial distribution of total PCB RBSL exceedances according to AWTA (Figures 4 and 9) to individual sample locations and corresponding concentrations (Figure 2) indicates the following:

- A significant concentration of exceedances occurs downstream of the SEFC and more in-line with the O Street CSO (the CSO is just to the left of and north of location NS4 on Figure 2), these exceedances are widespread, extending from the CSO shoreline to at least the middle of the river (locations 90, 92, 94, 120, AR13, AR14, AR21, AR22, AR23, AR24 (dup), and AR25 on Figure 2)
- Exceedances occur about mid-channel (locations AR26, AR27, AR28, AR29, AR30, AR31, AR32 (dup), AR33, AR34, AR36, and AR37 on Figure 2) and are separated from the SEFC and WNY shoreline by sediment concentrations significantly below the RBSL (locations 71, 72, 73, 77, 82, 84, 85, and 87 on Figure 2)

A similar comparison regarding the spatial distribution of total PAH exceedances (Figure 3) indicates the following:

- Exceedances occur about mid-channel (locations 72, 73, 75, 77, 79, 80, 82, 84, and 88 on Figure 3)
- An area of exceedances occurs downstream and near the shoreline from the Stickfoot Sewer (Stickfoot Outfall) (locations 79, 80, 81, and 119 on Figure 3)

5.0 CORRECTIVE MEASURES ALTERNATIVES AND FEASIBILITY EVALUATION

This section discusses corrective measures that are technically and practically proven to cleanup or remediate hazards associated with contaminated river sediments and discusses measures that could be implemented to address the contaminated sediments in the portion of the Anacostia River within SEFC property boundaries (Study Area). Corrective measures are discussed in order to comply with terms of the CD; however, it should not be construed as a recommendation that any one or combination of corrective actions is necessary. The corrective measures summarized below have been put forth by AWTA and AWRC (AWTA, 2002 and 2008) as feasible alternatives through extensive study and analysis. A brief analysis of the feasibility of implementing the AWTA preferred alternatives and the GSA recommended course of action is presented following the summary of available corrective measures.

5.1 Corrective Measures Alternatives

Four alternative corrective measures have been put forth by AWTA to address the six AOCs they identified (Figure 9). The alternative corrective measures include:

- **dredging to remove sediment** and land-disposal or beneficial re-use of sediments on land
- **capping contaminated sediments** in-situ
- **monitored natural attenuation**
- **thin-layer amendment/augmentation** and performance monitoring

Dredging involves the physical removal of contaminated sediments down to a pre-determined depth. **Dredging** is very disruptive to the benthic ecosystem due to the physical removal of the biota entrained in the removed sediment, displacement of other biota, and re-suspension of contaminated sediment into the river water which could migrate away from the AOC. The removed sediment (dredge spoils) must then be de-watered and transported for either re-use or disposal. Disposed dredge spoils must be kept from entering waterways at the point of disposal. This likely means the spoils would need to be capped on a daily basis to prevent runoff. AWTA suggested that the spoils might be able to be re-used beneficially (AWTA, 2002). The spoils are contaminated and thus it is difficult to find a retail market that will accept this type of material in an attempt to re-use it as fill, topsoil, cover material, etc.

Capping involves placing clean material, typically sand, over the contaminated sediment. Cap thicknesses vary from approximately 1 foot to 3 or more feet. Some caps are of multilayer construction (composite cap). The Hazardous Substance Research Centers South & Southwest (HSRC) completed installation of a composite cap approximately 3-feet thick downstream of AOC 6 in 2004. HSRC is a research consortium led by Louisiana State University. The cap consists of layers of sand and reactive layers that promote the capture of contaminants that may leach from the underlying contaminated sediment. HSRC monitored the cap for up to 24 months after installation. Eighteen months after installation they reported that all cap materials effectively isolated contaminants, but it was not yet possible to confirm if the active layer cap (composite cap) performed differently than a conventional all sand cap. Monitoring demonstrated that the composite cap was effective in controlling groundwater seepage rates across the cap but also showed the potential for gas to accumulate beneath the cap. HSRC noted that monitoring also showed deposition of new contaminated sediment onto the cap surface, “illustrating the importance of source control in maintaining sediment quality” (Reible et. al., 2006).

Monitored natural attenuation (MNA) is basically a variant of the default alternative that should be part of any corrective measures feasibility study – the No Action Alternative. **MNA** involves not taking any active remedial action, i.e., not removing or capping the sediments, and periodically monitoring the natural “clean-up” that occurs through natural processes (microbial and environmental degradation, mixing, dilution, dispersion, etc.). **MNA** has gained popularity among the environmental consulting industry and with regulators in recent years either as a remediation solution or as an end-stage step in closing out a remediation project. **MN**A is typically employed when recognized threats human health and the environment can be controlled through administrative controls (deed restrictions, land use restrictions, resource use restrictions) and regulatory restrictions.

Thin-layer amendment/augmentation and performance monitoring is essentially adding nutrients, biota, or chemicals to the contaminated sediment to promote and accelerate natural biodegradation or promote a chemical reaction that neutralizes or degrades contaminants. The chemical transformations are then monitored on a periodic basis. AWTA describes three such technologies that they believed could be used at AOCs not associated with the SEFC. The first technology, Limnofix™, is used to degrade PAHs and consists of injecting oxidants into the contaminated sediment to enhance biodegradation. The second technology is electrochemistry which can be used for mixtures of PAHs and PCBs. Electrochemistry involves applying an electric current to, and through, the contaminated sediment which changes the chemical nature of the contaminants. Side effects of electrochemistry include sterilizing the sediment (killing off the biota) and sediment disturbance caused by the need to create isolated “cells” of sediment that will be subject to the electrical reaction. The third technology is in-situ de-chlorination of PCBs. De-chlorination is achieved by adding reactive iron (zero-valent iron or palladium/iron colloid mixtures). AWTA reported, and URS confirmed for this report, that all three technologies have undergone bench-scale testing but no full-scale application of the technologies successfully remediating in-situ contaminated river sediments has been demonstrated.

5.2 Corrective Measures Feasibility

Initially **dredging, capping, and MNA** are considered feasible alternatives that could be implemented for the Study Area. The alternative of **thin-layer amendment/augmentation** and performance monitoring in a contaminated river sediment environment is judged to not be feasible or applicable to the Study Area because of the yet-to-be-proven success of this technology. AWTA conceded in their 2002 report that the three **thin-layer amendment/augmentation** technologies require further research, evaluation, and bench-scale testing before they can be recommended for implementation (AWTA, 2002).

In 2002, AWTA advocated **dredging** followed by filling the dredged areas with clean material in AOC 1. Based on AWTA's map (Figure 9) AOC 1 encompasses the western portion of the Study Area up to and including the former boat/loading dock area (terminus of 3rd Street, S.E.). This area would include sample locations NS4 and NS5 only (Figure 1). AWTA surmised that the depth of contamination was either not fully known in the AOC or that **dredging** would only remove the upper 3 feet of contamination. Composite layer **capping** was not considered feasible in 2002 because it reduced the depth of the river in the cap installation area by approximately 3 feet. There was concern that this would render the river bottom too shallow to allow for re-development of the Anacostia waterfront. In addition, dredging has the potential to re-suspend contaminated sediments, which could migrate to less contaminated areas downstream, remove (kill) or cause temporary displacement of benthic organisms and bottom feeding fish, and create new wastes (contaminated water and contaminated dredge spoils) that need to be treated and disposed of.

In 2008, AWTA advocated placement of a **12-inch thick sand cap** in AOC 1 (AWTA, 2008). Of the two active corrective measures being considered, this alternative has less potential to disturb and allow migration of the contaminated sediments, results in less disruption of benthic life, and does not generate new wastes that have to be treated and disposed of. However, it would require coordination with the whole Anacostia waterfront revitalization to ensure that lessening the river bottom depth by 1 foot in the Study Area would not interfere with future development plans.

In 2008, AWTA was advocating clean-up of all six AOCs by 2010. **MNA** is not feasible for attaining clean-up of the Study Area by 2010. **MNA** can be a low cost alternative corrective action provided certain pre-conditions are met. These include **no new** contaminants enter the area, natural processes are shown to attenuate (remediate) the contaminants within the desired timeframe, and the area will remain relatively undisturbed throughout the monitoring period. DDOE published a report in May 2008 setting the goal for a "fishable and swimmable" Anacostia River by 2032 (DDOE, 2008). AWTA reported that sediment deposition rates in the reach of the river that includes the Study Area currently are on the order of 1.5 centimeters per year. At current sedimentation rates the Study Area would naturally receive a sediment "cap" of about 35 centimeters (13.6 inches). River restoration goals include sediment source reduction and shoreline habitat restoration, both of which decrease downstream sedimentation rates. Benthic organisms tend to inhabit no more than the top 20 centimeters of bottom sediment (AWTA, 2002). Therefore, sedimentation rates upstream would have to be reduced by more than 42% in order to not have natural sedimentation deposit 20 centimeters of material in the Study Area by 2032.

All four alternatives universally require one important pre-requisite to be met: new contaminated sediment must be prevented from accumulating in the area being remediated. Clearly**, corrective actions should not be implemented without upstream source control**. AWTA has reported that the reach of the river that includes the Study Area is an active sediment depositional environment, the currently being 1.5 centimeters per year (AWTA, 2002). HSRC reported the accumulation (deposition) of new contaminated sediment on top of their demonstration cap in just 18 months time (Reible et. al., 2006). Source control would include controlling inputs to the river to prevent water-borne and sediment-borne contaminants entering the river, and controlling or remediating upstream contaminated sediments so they do not migrate downstream. DDOE made similar statements in their Anacostia River 2032 plan: "… however without reducing the flow of toxic sediments into the Anacostia, areas where contaminants are removed or capped could become recontaminated." and "… the District should prioritize the remaining hotspots so that once upstream loads are reduced, cleanup can begin on these sites." (DDOE, 2008). Also, in DDOE's *Strategies for Anacostia Toxic Pollutant Reduction in the District of Columbia* (Table 15 in DDOE, 2008) they predict that the timeline for completion of the clean-up of "hot spots" (AOCs) that are subject to upstream sediment loads will be on the order of 15 to 25-years.

6.0 CONCLUSIONS AND RECOMMENDATIONS

GSA does not believe that corrective measures should be implemented to address the contaminated near shore river sediments within the confines of the SEFC property boundary because the human health and ecological risk evaluation of these sediments concludes that they do not pose an unacceptable risk to human health (URS, 2008). The river sediments human health and ecological risk evaluations were reviewed and approved by the USEPA on July 17, 2008. The finding of no unacceptable risk to human health is based on the following conclusions reached in the USEPA approved report (RFI 2004b):

- For the sediments to pose a risk to human health they would have to be removed from the river, placed on land, and then be allowed to come in contact with humans
- No routes of exposure to humans currently exist since the sediments are at the bottom of the river

GSA believes that the sediments sampled by URS in 1999 are no more of a threat to the river ecosystem than the sediments located throughout the reach of the Anacostia River where the SEFC is situated, between the South Capital and 11th Street Bridges. This belief is supported by the following conclusions made in the USEPA approved river sediment ecological risk evaluation (URS, 2008) and in recently published reports (AWTA, 2008 and DDOE, 2008):

- The average total PCB concentration of the 1999 River Sediment Data was not significantly different from average concentration in two other data sets (Recent

Watersheds Project data and Watershed Project Background data), the Watershed Project Background data are that which represents background concentrations (see Figure 2 for the spatial distribution of total PCB sediment concentrations in this reach of the river)

- Total PAH concentrations in the Recent Watershed Project data and Watershed Project Background data are more than two times (2x) greater than those in the 1999 River Sediment Data (see Figure 3 for the spatial distribution of total PAH sediment concentrations in this reach of the river)
- Total PCB and total PAH concentrations in sediment throughout the Anacostia River exceed benchmarks (RBSLs) indicative of high probability of adverse risk effects on benthic communities (Figures 4, 5, 6, and 7)
- The GSA ecological risk evaluation for this reach of the Anacostia River concluded:
    - A potential exists for adverse ecological effects (from PCBs, PAHs, and metals) for all receptors studied including benthic invertebrates; herbivorous, semi-aquatic mammals (muskrat); birds which feed on aquatic life (heron); and fish which feed on benthic invertebrates (sunfish)
    - A potential exists for excess cancer risk and adverse non-carcinogenic health effects for a recreational fisherman consuming fish from the river, however, issuance of fish consumption health advisories and restrictions are in-place to limit and prevent fish consumption thus mitigating the risk/adverse health effect

GSA believes that development and implementation of corrective measures is not feasible or required based on the following:

- No corrective measures specific to near shore river sediments are included in the July 17, 2008 USEPA approval of the RFI Report or ecological risk evaluation, if contamination posed an imminent threat to human health or the environment the USEPA would have issued GSA a directive to prepare and implement corrective measures
- Contaminant inputs to the river must be controlled, and upstream contaminated sediments must be kept from being transported downstream before corrective measures can be implemented (Reible et. al., 2006 and DDOE, 2008)

Therefore, GSA recommends that a determination be made that they have satisfied the requirements of paragraphs 10, 11, and 12 of the CD and are released from taking further actions required by the CD. GSA will continue to comply with the terms of the USEPA RCRA CO and take appropriate actions, including implement future corrective measures, as directed by the USEPA.

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8.0 ACRONYMS

AOC	Area of Concern
Apex	Apex Environmental, Inc.
AWRC	Anacostia Watershed Restoration Commission
AWS	Anacostia Watershed Society
AWTA	Anacostia Watershed Toxics Alliance
BTAG	USEPA Biological Technical Assistance Group
CD	Consent Decree
CMS	Corrective Measures Study
CO	Final Administrative Order on Consent
CSO	Combined Sewer Outfall
D.C.	District of Columbia
DDOE	District Department of the Environment
DOJ	U.S. Department of Justice
DOT	U.S. Department of Transportation
EJ	Earth Justice
ESA	Environmental Site Assessment
GSA	U.S. General Services Administration National Capital Region
HQ	Hazard Quotient
HSRC	Hazardous Substance Research Centers South & Southwest
K&D	Kaselaan & D'Angelo Associates, Inc.
MNA	Monitored Natural Attenuation
NAS	National Academy of Sciences
NOAA	National Oceanic Atmospheric Administration
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PEL	Probable Effects Limit
ppb	Parts Per Billion
RBSL	Risk Based Screening Level
RCRA	Resource Conservation and Recover Act
RFI	RCRA Facility Investigation
S.E.	Southeast

SEFC	Southeast Federal Center
SVOC	Semivolatile Organic Compound
SWC	Space and Warfare Command
TAL	Target Analyte List
TCL	Target Compound List
TEL	Threshold Effects Limit
URS	URS Group, Inc.
URSGWC	URS Greiner Woodward Clyde Federal Services
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency - Region III
VOC	Volatile Organic Compound
WASA	District of Columbia Water and Sewer Authority
WCFS	Woodward-Clyde Federal Services
WNY	Washington Navy Yard

FIGURE 1

1999 RIVER SEDIMENT DATA SAMPLE LOCATIONS

FROM URS, 2008

CLIENT	General Services Administration			
PROJ	South East Federal Center			
REVISION NO	2	DES BY	MTG	01/27/07
SCALE	1:7,000	REV BY		
G:\Projects\Z_Short_Term_Projects\South East Federal Center\Projects\Figure_1_20070313.mxd		CHK BY	SS	01/27/07

N

TITLE URS SE Federal Center Sediment Samples - Total PCBs & Total PAHs

URS 200 Orchard Ridge Drive Gaithersburg, MD 20878

PROJ NO 15298209.13001

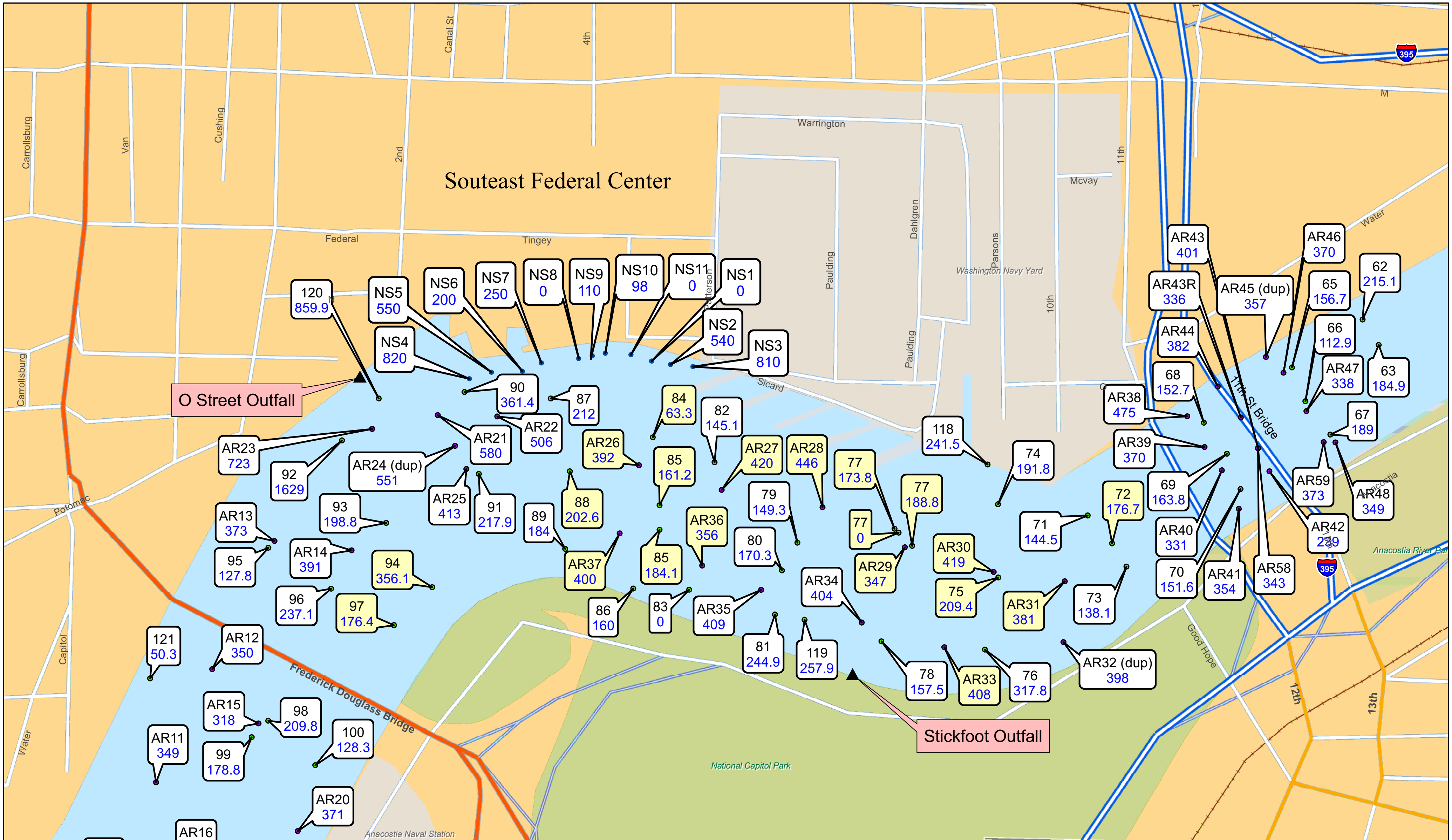
FIGURE 1

FIGURE 2

TOTAL PCB CONCENTRATIONS IN RIVER SEDIMENT

11TH STREET BRIDGE TO SOUTH CAPITAL STREET BRIDGE

FROM URS, 2008



Legend

- SPWR Sample Locations
- ANS Sample Locations
- PCB Sediment Samples
- Outfall Locations
- Yellow label indicates sample used for background

0 500 1,000 Feet

Units: ug/kg

CLIENT	General Services Administration			
PROJ	South East Federal Center			
REVISION NO	1	DES BY	MTG	01/27/07
SCALE	1:5,000	REV BY		
G:\Projects\Z_Short_Term_Projects\South East Federal Center\Projects\Figure_2_20070313.mxd		CHK BY	SS	01/28/07

N

TITLE Anacostia River Sediment Samples - Total PCBs

URS

200 Orchard Ridge Drive
Gaithersburg, MD 20878

PROJ NO 15298209.13001

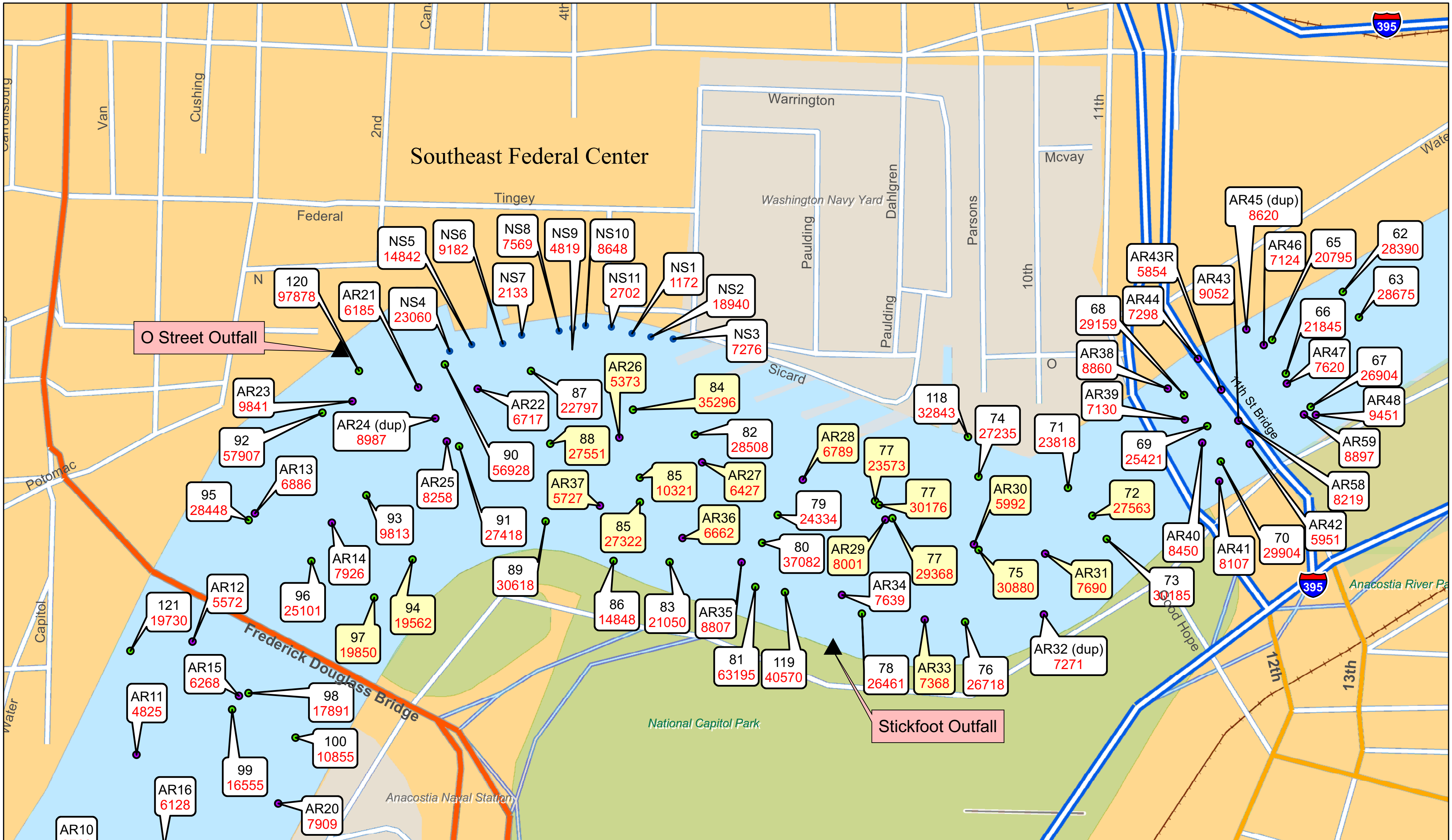
FIGURE 2

FIGURE 3

TOTAL PAH CONCENTRATIONS IN RIVER SEDIMENT

11TH STREET BRIDGE TO SOUTH CAPITAL STREET BRIDGE

FROM URS, 2008



Legend

- SPWR Sample Locations
- ANS Sample Locations
- PCB Sediment Samples
- Outfall Locations
- Yellow label indicates sample used for background

0 500 1,000 Feet

Units: ug/kg

CLIENT	General Services Administration				
PROJ	South East Federal Center				
REVISION NO	1	DES BY	MTG	01/27/07	
SCALE	1:5,000	REV BY			
G:\Projects\Z_Short_Term_Projects\South East Federal Center\Projects\Figure_3_20070313.mxd		CHK BY	SS	01/28/07	

N

TITLE
Anacostia River Sediment Samples - Total PAHs

URS
200 Orchard Ridge Drive
Gaithersburg, MD 20878

PROJ NO 15298209.13001

FIGURE 3

FIGURE 4

TOTAL PCB CONCENTRATIONS IN SEDIMENT

ANACOSTIA RIVER

FROM DDOE, 2008

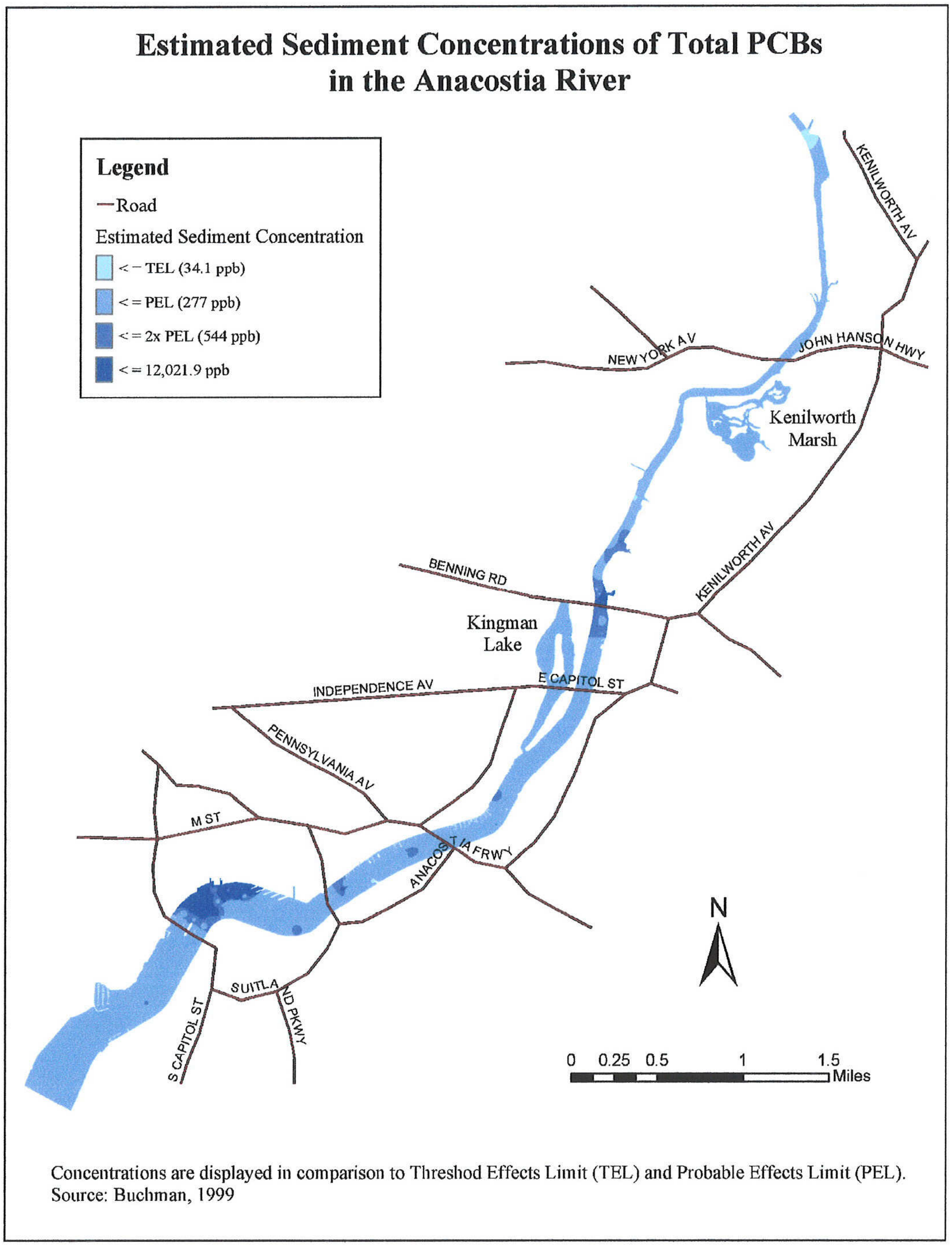


Figure 3-5. Estimated total PCBs concentrations (ppb) in Anacostia River surficial bed sediments

FIGURE 5

TOTAL PAH GROUP 1 CONCENTRATIONS IN SEDIMENT

ANACOSTIA RIVER

FROM DDOE, 2008

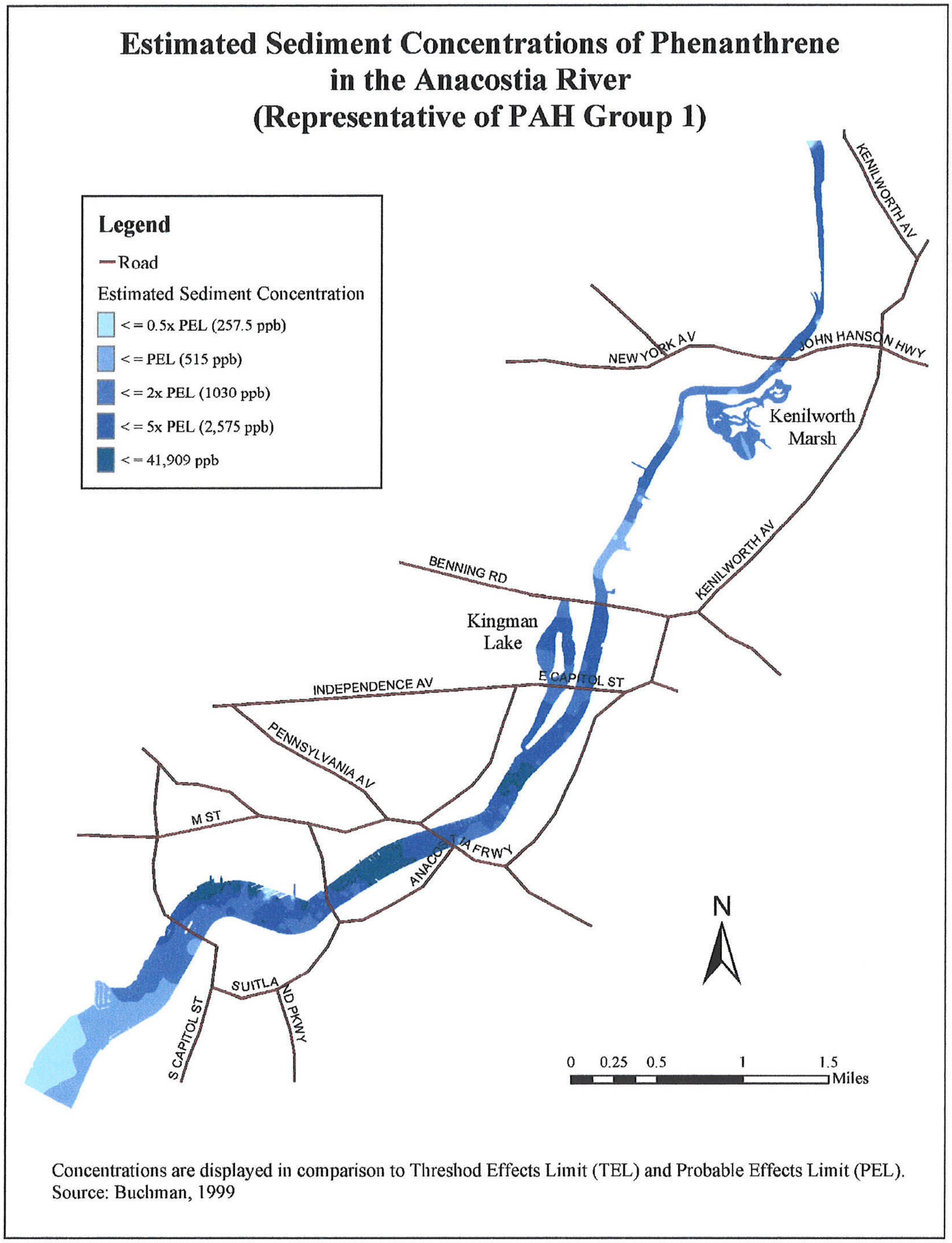


Figure 3-6. Estimated phenanthrene (representative of PAH Group 1) concentrations (ppb) in Anacostia River surficial bed sediments

FIGURE 6

TOTAL PAH GROUP 2 CONCENTRATIONS IN SEDIMENT

ANACOSTIA RIVER

FROM DDOE, 2008

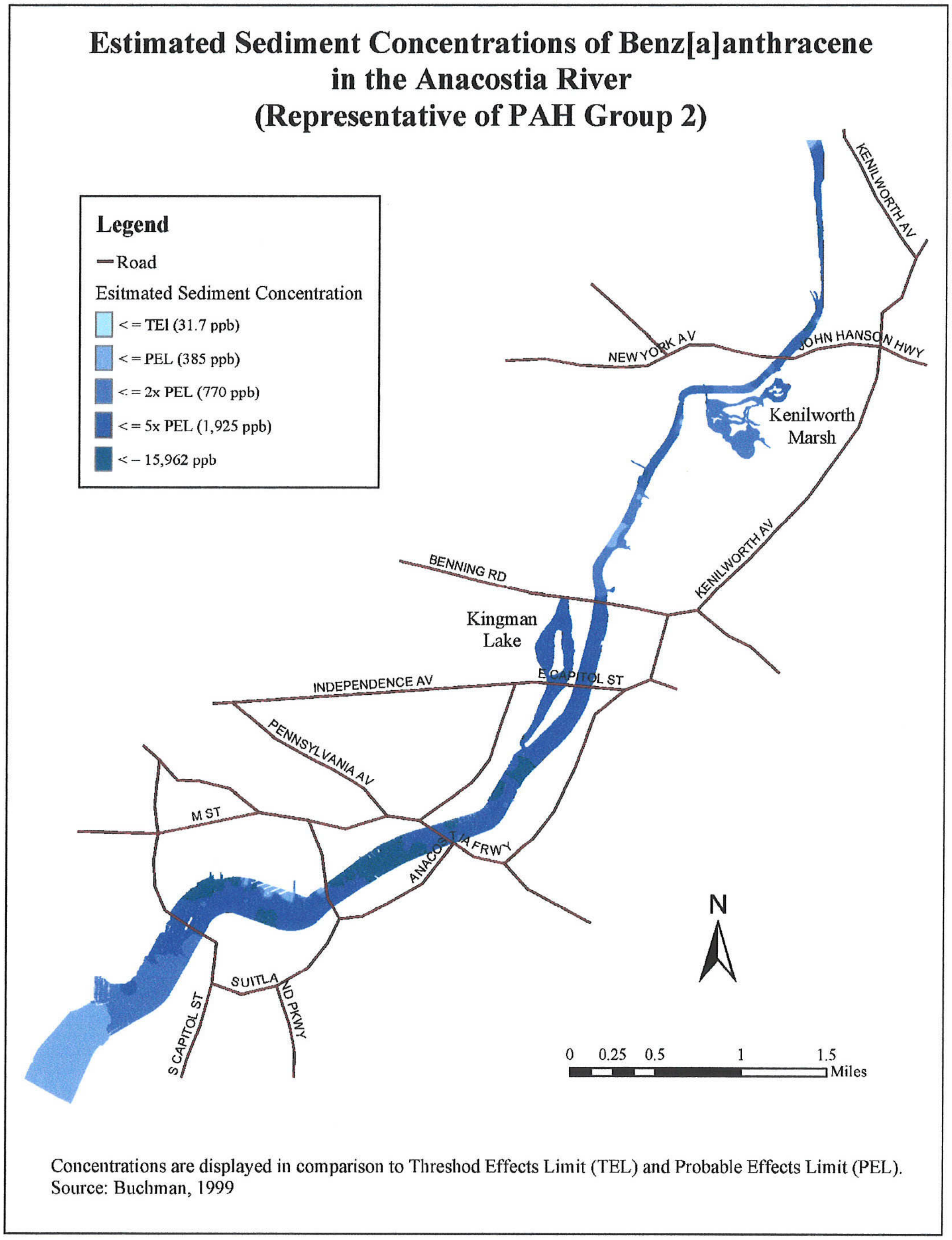


Figure 3-7. Estimated benz[a]anthracene (representative of PAH Group 2) concentrations (ppb) in Anacostia River surficial bed sediments

FIGURE 7

TOTAL PAH GROUP 3 CONCENTRATIONS IN SEDIMENT

ANACOSTIA RIVER

FROM DDOE, 2008

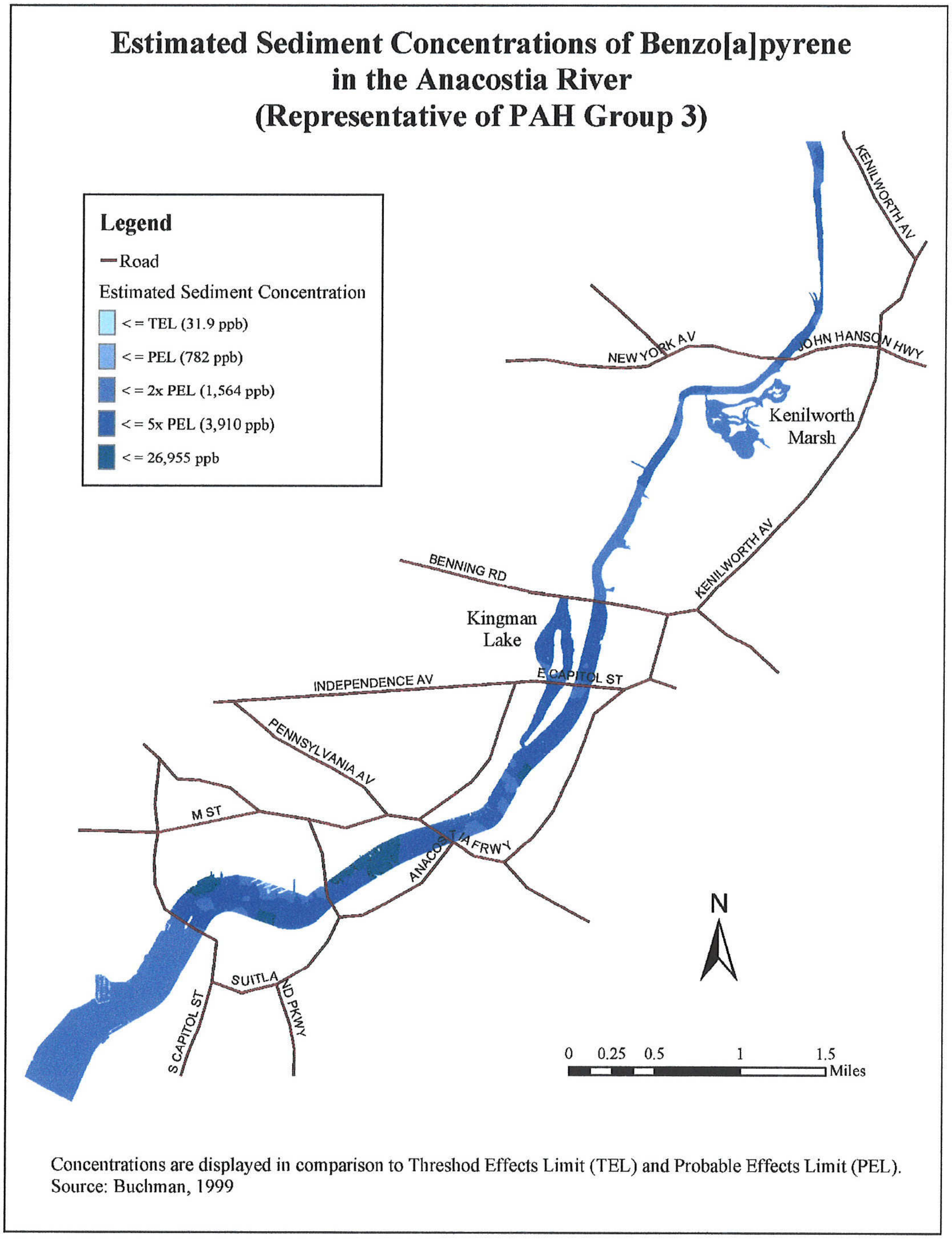


Figure 3-8. Estimated benzo[a]pyrene (representative of PAH Group 3) concentrations (ppb) in Anacostia River surficial bed sediments

FIGURE 8

KEY LANDMARKS ALONG ANACOSTIA RIVER

RELEVANT TO SEDIMENT CONTAMINATION

FROM AWTA, 2002

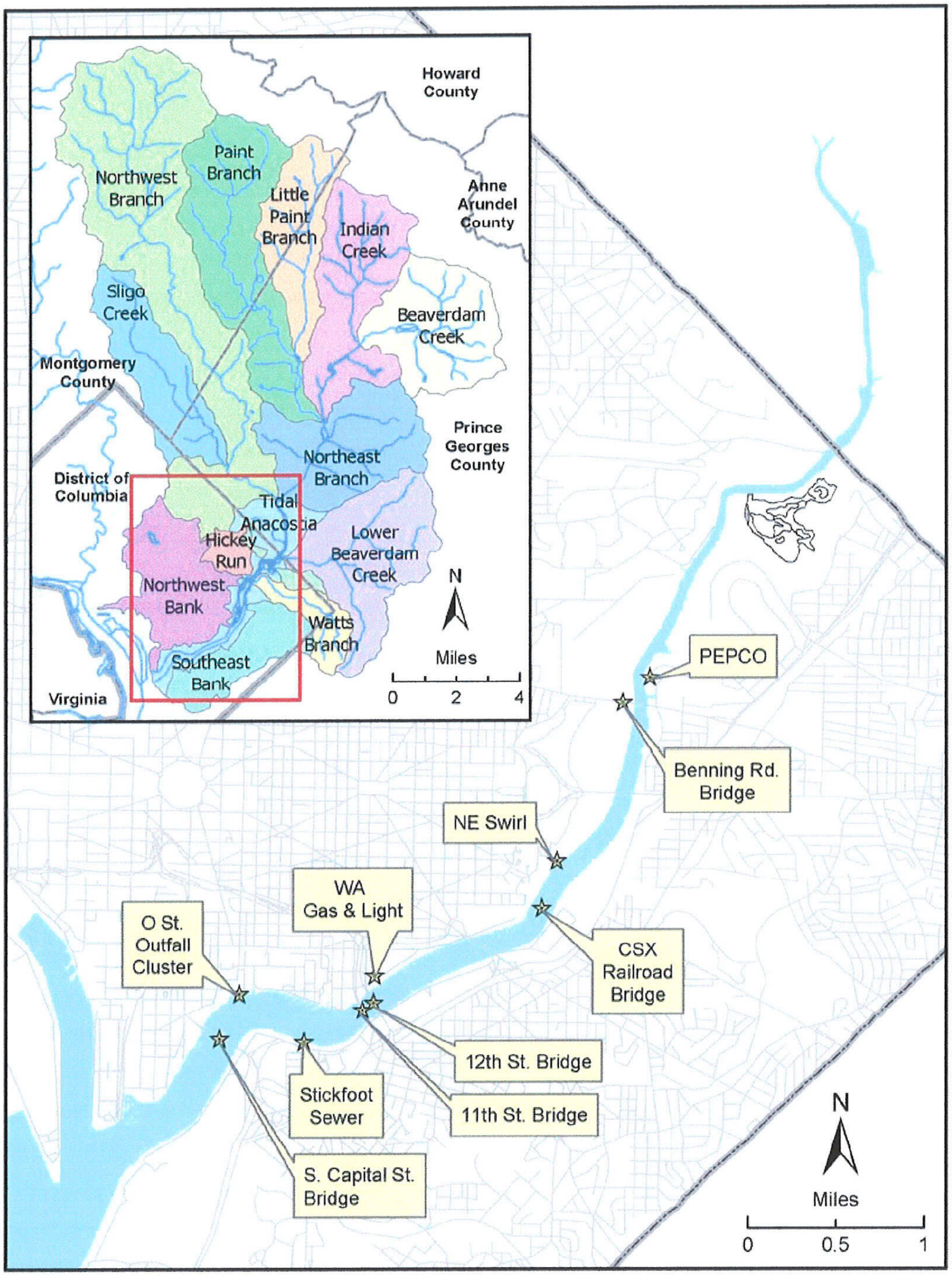


Figure 1: Anacostia River watershed showing subwatershed divisions and major tributaries.

FIGURE 9

CONTAMINATED SEDIMENT AREAS OF CONCERN

ANACOSTIA RIVER

FROM AWTA, 2002

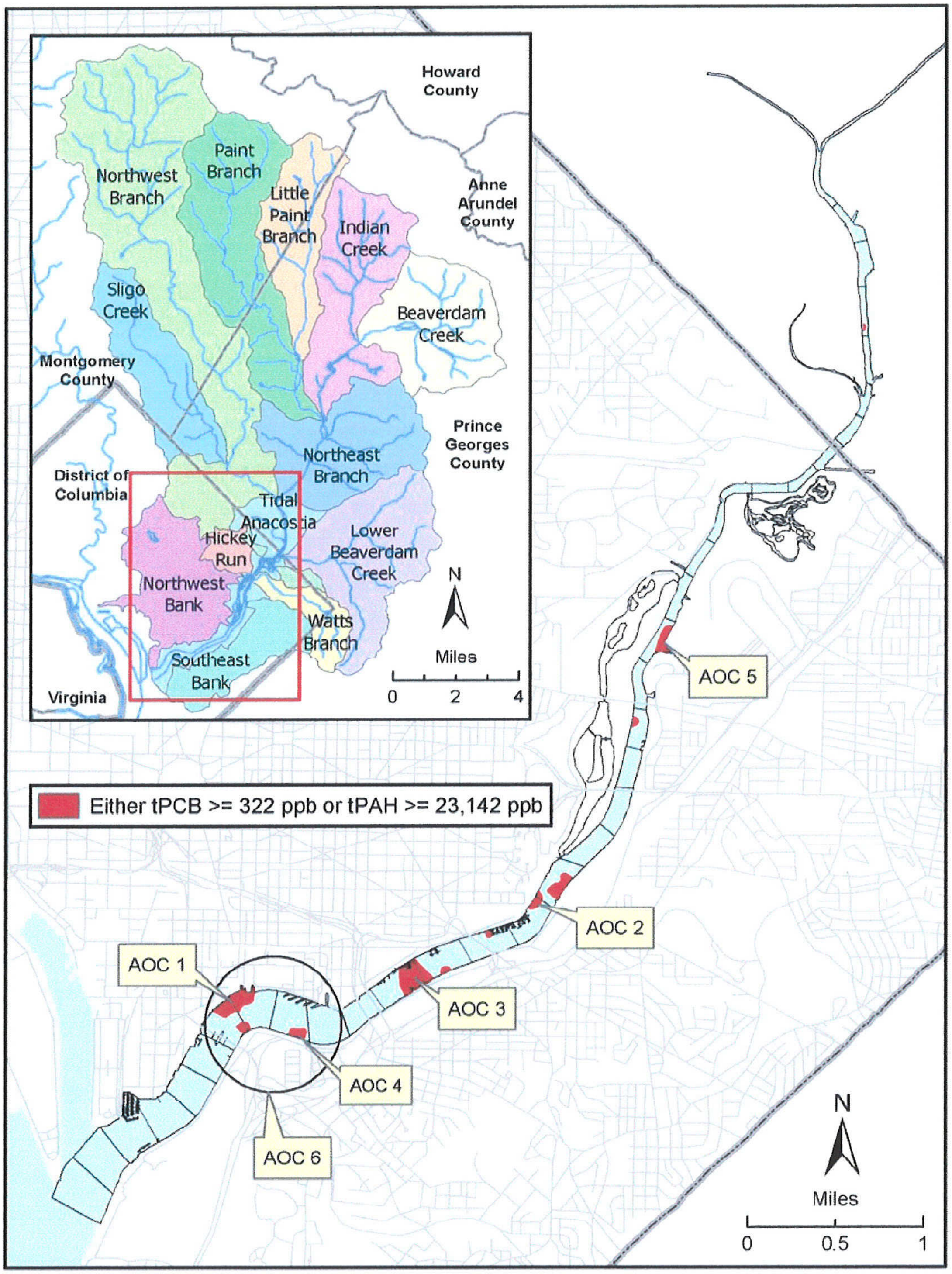


Figure 13 Areas identified for potential active remedial actions.